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Mr. Chairman, Members of the Committee, for the record, my name is Jasen Bronec, manager of Glacier Electric Cooperative.

The intent of my testimony is to discuss distributed generation (DG) interconnection from the perspective of a distribution utility. This brief overview will cover potential benefits, barriers, technical issues, marketing, and regulatory policy.

Benefits

DG seems to only make sense in specialized niche applications. Currently, Glacier Electric has looked to DG to offset expensive line extension costs to stock wells or remote telemetry sites. These applications use a minimal amount of power and at times do not justify the cost of a line extension. Also, some utilities have used DG to help offset needed system upgrades. All of these applications are subject to location.

Distributed Generation has continued to be encouraged by various forms of subsidy such as demonstration project grants, tax credits, and regulatory policies such as net metering. At present time, overall penetration of DG in the North America power system is very small, and any system issues presented by DG are localized to those few power lines where DG penetration has become significant. DG capacity costs and operating costs are generally not competitive with grid power for most applications at this time.

In general, benefits at this time are minimal and any benefits are subject to niche applications.

Barriers

Distribution systems are conventionally designed with the assumption that the flow of power is always from the substation to the end user. Similarly, the only source of short-circuit, fault detection current, capacity is assumed to be provided via the primary substation. Installing generation on a distribution system invalidates these assumptions, and introduces a range of system issues. These issues are covered under the technical issues sections.

Furthermore, not all distribution utilities are the same and can not be subject to the same legislative mandates. Each distribution utility has different customer density, financial

considerations, and diversified operating area. It is absolutely impossible to create uniform, "One Size Fits All" legislation.

Technical Issues

The IEEE has established standards to assist in interconnection of DG. Standards are in place to first ensure safety of line workers and the public. The standards then help with the protection of customer and utility equipment.

All technical issues are subject to the amount of DG penetration on the distribution system. A larger distribution system has a greater ability to integrate DG. For this reason, many small distribution systems, like those of Montana's electric cooperatives, have been concerned with the ability of the distribution system to handle DG. As DG is added to a distribution system, many technical issues can arise. These issues include:

Voltage regulation – Power output from DG distorts feeder voltage profiles, and can interact with voltage control devices such as voltage regulators and switched capacitor banks. This can result in overvoltage and undervoltage conditions for other customers.

Fault current contribution – Additional fault current contributed by DG can result in exceeding equipment capabilities. More importantly, feeder protection can be desensitized, making fault detection more difficult. Uncoordinated operation of fuses and reclosers, cased by DG short circuit contribution, can result in unnecessary customer outages.

Inadvertent islanding – Operation of feeder breakers, reclosers, fuses or sectionalizers can isolate a DG along with other customers. It is possible for the DG to continue in operation, providing energization which is out of the control of the utility. Such islands are not synchronized to the utility system, and reclosing can create widespread damage to utility and customer equipment. Thus, such islands are to be avoided, or quickly detected and eliminated. Conventional means for detecting islanding entails relatively sensitive voltage and frequency trip points, which are likely to be falsely triggered by other events.

Grounding and distribution system over-voltage - The DG interconnection can provide an ungrounded source to a normally grounded primary feeder, making severe over-voltages possible, which could lead to widespread destruction of utility and customer equipment. An excessively strong ground source, however, can interfere with feeder ground fault protection. In ungrounded or uni-grounded primary systems, the DG must not provide an undesired ground source. Thus, attention to grounding considerations is essential to DG interconnections.

Power Quality – Inverter interfaced DG equipment can be a substantial injector of harmonic currents, increasing system distortion levels and possibly leading to equipment heating, capacitor unit failure, and resonant over-voltages. Certain types of DG, with variable output can result in rapid voltage fluctuations causing unacceptable lamp flicker.

Network interconnection – DG interconnection to secondary spot or grid networks are particularly problematic. A number of scenarios can lead to reverse power flow through all of the protectors on a network, isolating the network for the utility system. This can lead to outages of the network and be destructive to the distribution system protectors.

Isolation of multiple source generation – Lineman are required, by OSHA, to isolate and ground all sources of power before working on a de-energized line. This becomes more problematic with multiple sources of power. First, it increases the risk of a power source not being isolated correctly and resulting in a lineman being electrocuted. Second, it increases the amount of time it takes to attend to outages and can create hazards to the welfare of the public.

Cold load pickup - DG should trip due to faults on the distribution feeder or laterals to which it is connected, or soon thereafter when the breaker or reclosers opens. When reclosing occurs, the load previously carried by the DG must now be picked up by the power system, as the DG is normally not allowed to come back on line until after the utility system has been reenergized without further tripping for some period. The additional load increases the amount of pickup current seen by the substation relays. If the protection settings are based on the net load with DG in operation, the pickup current could cause undesired tripping of the power system.

A common misconception is that DG will increase distribution system security and reliability. While the DG may provide backup power for the facility where it is installed, the net impact of the DG on distribution system reliability, using current interconnection practices, is more likely to be negative than positive.

Marketing

Presently, DG is economically favorable only in niche applications. It will move to the mainstream only if its capital and operating costs decrease, or if centralized generation becomes relatively more expensive, unobtainable (due to plant siting issues), or undeliverable because transmission capacity cannot be installed.

Net Metering

In Montana, net metering has been a "hot topic." Power generated by the customer in excess of their demand flows back into the system and reduces the kWh for which the customer is charged. Net metering effectively means that the customer is able to sell power generated in excess of their demand back to the utility at the same price per kWh as the customer purchases power.

Net metering can greatly increase the economic viability of a DG project. Such tariffs can be burdensome to the utility, and consequently to other non-DG members, because the value of energy at periods of peak demand is much greater than at minimum demand. If the usage of the customer follows the system demand curve, the customer takes high cost energy and pays the kWh back when the value of the energy is less. Effectively, net metering is a subsidy of the DG at the expense of other ratepayers.

In the last year, some utilities have had pressure from renewable energy developers to increase the generator size and extend true-up periods for net metering generators. The only reason for this is to make a DG unit more economically feasible and have the subsidy burden paid by all ratepayers.

Regulatory Policy

It is prudent that utilities establish practices and policies which will accommodate the integration of DG. All Montana electric cooperatives have DG interconnection policies and net metering policies. For reasons outlined in this paper, each cooperative has tailored a policy that best fits their members.

Summary

In closing, a "One Size Fits All" policy is not appropriate for DG interconnection. Each utility needs to consider many different benefits, barriers, and technical issues.

If you have any questions, please feel free to call me at Glacier Electric Cooperative (406) 873-4165. Information contained in this paper comes from experiences at Glacier Electric and the Cooperative Research Network (CRN).